

STUDIES OF ORIENTAL STENOGASTRINAE (HYMENOPTERA VESPOIDEA)

by

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With 49 text-figures and two plates

This is the third of a series of studies on the Stenogastrinae, an isolated and in many respects particularly interesting group of subsocial wasps. It is also the first paper to deal with the species of the Oriental region, where the group is much more numerous and diverse than in the Papuan subregion. Whereas only 17 species, belonging to two genera, are known from the latter area (Van der Vecht, 1972, 1975), the Oriental region harbours about 50 species belonging to five genera, two of which are new and described in this paper.

It is my intention to discuss the phylogeny and zoogeography of these wasps after the completion of the taxonomic revision. It appears desirable, however, to present at this stage a few notes on the relationships and the status of this group as a whole.

The first author to deal with this question was H. de Saussure (1853, vol. 2: 4), who divided the "Vespides", often called Diploptera¹⁾ or diplopterous wasps, into "Masariens", "Euméniens" and "Vespiens". Concerning the genus "*Ischnogaster*" (junior objective synonym of *Stenogaster*, the only valid genus-group name available for these wasps before 1914) this author wrote: "Ce genre est, par tous ses caractères, entièrement intermédiaire entre les deux tribus [Euméniens and Vespiens, solitary and social wasps, resp.]. Ses mœurs seules obligent à le classer dans les Guêpes sociales."

Since then there has been little agreement with regard to the question whether the Diploptera should be treated as a single family, embracing three or more subfamilies, or as a superfamily containing two (Börner, 1919) or three families, which in the latter case agree with the groups distinguished by De Saussure. That this question is of some importance in connection with the systematic position of the Stenogastrinae, may be shown by some examples of classifications proposed or used in the past.

¹⁾ The name "Diploptera", originally proposed by Latreille, in Cuvier, 1817, Règne Anim. 3: 502, was rejected by De Saussure, because the longitudinal folding of the fore wings when at rest does not occur in certain "Vespides", whereas it is also seen in certain wasps not belonging to this group "(les Leucospidiens, par exemple)" (De Saussure, 1853, vol. 1: XVI). Nevertheless I shall use this term here, because it appears to be the only available unambiguous name for the "Vespides" sensu De Saussure.

Smith (1857) used the term *Diploptera*, gave the three divisions family rank, and placed *Ischnogaster* in the *Vespidae*. Dalla Torre (1894, 1904) followed the classification as given by De Saussure. Bingham (1897) also treated *Ischnogaster* as a member of the family *Vespidae* s. str., but remarked that this genus seems to form "a link between the *Eumenidae* and *Vespidae* both in structure and in habits." Ashmead (1902) placed the three families of *Diploptera*, together with 13 other families of *Hymenoptera* (including *Trigonalidae*, *Bethylidae*, *Chrysididae*, *Pompilidae*, *Mutillidae*, etc.), in one superfamily *Vespoidea*; he created a new subfamily *Ischnogasterinae*, containing the African genus *Ischnogasteroides* Magretti¹⁾ in addition to the type-genus, and placed this in the *Eumenidae*.

Bequaert (1918) and Bradley (1922) provided a classification in which all the diplopterous wasps are regarded as a single family (*Vespidae*), subdivided in 10 or 11 subfamilies, 2 or 3 of these corresponding with the former family *Masaridae*, 3 with the *Eumenidae*, and 4 with the *Vespidae*. By placing the *Stenogastrinae* in between the two last mentioned groups, the problem of the relationships of this subfamily remains completely open, since no choice between the viewpoints of De Saussure and Ashmead is necessary.

Börner (1919) divided the *Diploptera*, which he called "*Vespina*", into two families, each with two subfamilies: *Vespidae* with *Vespinae* and *Eumeninae*, and *Masaridae* with *Masarinae* and *Celonitinae*; he could not examine *Ischnogaster* and *Ischnogasteroides*, which he regarded as social wasps, but suggested that these might be closely related to the *Eumeninae*.

In more recent literature, the term *Vespoidea* is either used for a group of several families, including the *Diploptera* (Imms, 1925 and later editions; Essig, 1942; Bradley, 1958; Brothers, 1975), or exclusively for the *Diploptera*. In the latter case, the superfamily may either contain one family *Vespidae* with several subfamilies (Brues & Melander, 1932; Muesebeck c.s., 1951) or the usual three families (Richards, 1962). The latter classification is here of particular interest, because it requires an answer to the question of the affinities of the *Stenogastrinae*. Richards decided to place them again in the family *Vespidae* s. str. (social wasps), although it is evident from his enumeration of the characters of this group (l. c.: 22), that they take a very isolated position there.

Since then, the further study of these wasps has brought to light that the differences between the *Stenogastrinae* and the other social wasps (*Polistinae* and *Vespinae*) are considerably greater than would appear from this enumeration. Richards himself has already pointed out that the *Stenogastrinae* differ from all other *Vespoidea* in having the small subcircular pronotal lobe at a point almost halfway between the tegula and the fore coxa (Richards, 1972). This character, together with some others (long pointed clypeus and long narrow mandibles lying alongside it) led him to remark that the *Stenogastrinae* are very different from other social wasps and might even have evolved independently from some *Eumenes*-like, solitary ancestor (Richards, 1971).

Spradbery (1975: 317) compared the *Stenogastrinae* with the *Eumenidae* and

¹⁾ This is a small group of solitary wasps which are structurally very close to *Eumenes*; Ashmead's error was corrected by Meade-Waldo (1913: 54).

other Vespidae for 17 "biological characteristics"¹⁾ and concluded that "the Stenogastrinae exhibit a number of unique features which suggest that they originated from an early vespoid ancestor and diversified in the specialized environment of the deeply shaded rain forest."

In the course of my studies of the Stenogastrinae some other characters have been noticed which lend support to these ideas.

(1) Glossa and paraglossa do not have sclerotized pads (acroglossal buttons) at their tips²⁾. The Stenogastrinae agree in this respect with certain primitive Masaridae. The absence of such pads in the few Stenogastrinae known to him was already noted by De Saussure (1852a: 22; 1853, vol. 2: 3, footnote 1).

(2) The occipital keel runs down ventrally to meet the hypostoma close to its base (see Richards, 1962: 11, and this paper, Fig. 1 and 2). This condition is not found in the Polistinae and Vespinae. But the keel forks in several Zethinae³⁾ and in the South American genus *Plagiolabra*, one branch going to the hypostomal keel and one to the mandible base. In some American *Zethus* species (*Z. cinerascens* Saussure, *cristatus* Fox, *spinipes* Say, and probably others) the mandibular branch is almost or entirely absent, and the situation is then very similar to that found in the Stenogastrinae.

(3) Mandibles projecting beyond tip of clypeus, at least in ♀ of some genera distinctly crossing when at rest (Van der Vecht, 1972, Fig. 1 and 14), tridentate in ♀, often more or less reduced in ♂ (in Eumenidae and Vespidae the mandibles of ♀ usually have 4 or 5 teeth).

(4) Clypeus of ♀ pointed at apex (in ♂ sometimes rounded), differing from clypeus of many Polistinae (♀) in absence of projecting lateral angles of anterior margin.

(5) Antennal sockets far apart, close to centre of eye-emargination, separated from upper margin of clypeus (often only weakly indicated) by long (*Liostenogaster*) to very long (*Stenogaster*) supraclypeal area.

(6) Apart from some characters already mentioned previously (see Richards, 1962), the wings of the Stenogastrinae are distinguished by (a) the shape of the marginal cell (marginal vein bluntly angled at end of first abscissa, where r meets Rs, and then running in an almost straight line to wing margin) and (b) by the presence of only two closed cells in the hind wing, the costa being more or less distinctly reduced distally. The row of hamuli is often once or twice interrupted.

(7) The male genitalia, particularly aedeagus and volsella, are rather different from those of other diplopterous wasps, but are perhaps most similar to those of certain Zethinae.

(8) The gaster (metasoma) of the pupa is strongly bent at the articulation of

¹⁾ This author has overlooked (Table 2, line 2) that Raphiglossinae and Zethinae³⁾ are known to use plant materials for nest construction.

²⁾ The statement about the occurrence of acroglossal buttons in the Vespidae (Richards, 1962: 22) should be corrected by inserting "(except in the Stenogastrinae)" after the word "present".

³⁾ Richards (1962: 4) and Bohart & Stange (1965) have used the name Discoelinae Thomson, 1874, for this subfamily, but in accordance with article 11 (e) of the Code the name Zethinae Saussure, 1855, originally proposed as "Zethites" for a group containing the genera *Calligaster*, *Zethus* and *Discoelius*, has priority.

segments 1 (petiole) and 2. This phenomenon does not occur in the Polistinae with petiolate abdomen (the body of the pupa of *Belonogaster*, for example, is perfectly straight), but it is well known from several Eumenini (example: photograph of pupae of *Delta emarginatum* (L.) in Bonelli, 1973). Less attention has been given to the pupae of the Zethinae, the other Eumenid group of cell-builders with petiolate gaster. Except for a figure of the pupa of *Calligaster williamsi* Bequaert ("*Zethus cyanopterus*") in Williams' paper on the biology of Philippine wasps (1919: 162, Fig. 94), which clearly shows "its bent attitude", I looked in vain for information on this subject in some literature directly at hand. The only pupa figured in Bohart & Stange's (1965) revision of American *Zethus* seems to have the gaster very slightly curved, but the drawing is small and rather schematic.

Fortunately I could study the pupae from nests of some *Zethus* spp. collected in Surinam by Mr. G. van Vreden (*Z. prominens* Fox, no. 133 Mus. Leiden, and *Z. miniatus* Sauss., no. 123) and by myself (*Z. binodis* (F.), no. 226). The first-mentioned species is an interesting exception to the rule that the members of the subgenus *Zethus* nest in insect burrows in twigs or wood; the nest found by Van Vreden at Afobaka in a hollow tree is an irregular cluster of more than 30 cells, each measuring about 3×1.5 cm, built of vegetable material consisting mainly of fragments of parts of inflorescences of an unidentified plant species, pasted together with a resinous substance. A pupa from this nest has the gaster sharply bent, the angle between the axis of the petiole and that of the remaining segments being about 70° . In a pupa of *Z. (Zethoides) miniatus* this angle is about 50° , and in one of *Z. binodis*, which belongs to the same subgenus but has a relatively longer petiole, it is only 35° . The few available figures seem to suggest that the angle becomes sharper with increasing length of the petiole, but much more information is required for a reliable conclusion. It would be particularly interesting to have data on the pupae of species which resemble Stenogastrine wasps more closely in petiolar length, such as certain members of the groups of *Z. fuscus* (Perty), *Z. strigosus* Saussure, and *Z. montezuma* Saussure.

However, it is already possible at this stage to establish that the pupae of certain Zethinae are very similar to pupae of Stenogastrinae, as figured by Iwata (1967, *Parischnogaster* spp., Figs. 6-9, angle of gaster $25-45^\circ$) and Spradbery (1975, *Stenogaster concinna*, Fig. 9, angle about 50°).

Some provisional conclusions from the data now available are:

(a) The Stenogastrinae are so different from the Polistinae and the Vespinae, both in morphological and in ethological characters, that a taxon consisting of these three groups cannot be regarded as monophyletic.

(b) The Stenogastrinae are likely to have evolved from a solitary cell-building ancestor with elongate gastral petiole.

(c) Several characters, including those mentioned above under 2, 3, 7 and 8, suggest that this ancestor was more closely related to the Zethinae than to the Eumenini.

(d) Data on geographic distribution are not in contradiction with this theory. The present distribution and diversity of the Zethinae in the Old World indicate that this subfamily has been represented here long enough to allow for the radiation of the Stenogastrinae in the Indo-Australian area.

The consequences of these conclusions for the classification of the Diploptera should be further studied in the framework of a revision of this group by modern methods, for which Brothers' recent study of the Aculeate Hymenoptera (1975) may serve as an example. Meanwhile, if one accepts the subdivision of the Diploptera into three (or more) families, a choice must be made whether to treat the Stenogastrinae as a separate family or as a subfamily of the Eumenidae. In my opinion the latter solution would then be preferable. However, I agree with Richards (in litt., July 1976) that the best course might perhaps be to treat the diplopterous wasps again as one family with several subfamilies, approximately those listed on p. 4 of his revision of the Masaridae.

KEY TO THE GENERA OF THE STENOGASTRINAE

1. Propodeum posteriorly with a very short constricted neck; its extreme edge slightly raised, seen in profile as forming a minute tooth above the gastral muscle. Head (excluding clypeus and mandibles) subcircular, at most moderately wider than high (13 : 10). Mandibles of ♂ without teeth, rather abruptly narrowed from the middle, the apex curved and acute. Clypeus of ♂ flattened to concave. Posterior margin of hind wing of ♂ normal. — New Guinea and some neighbouring islands *Stenogaster* Guérin
- Posterior edge of propodeum not raised. Head (excluding clypeus and mandibles) as a rule much wider than high. Mandibles of ♂, if without teeth, not abruptly narrowed. Clypeus of ♂ more or less convex. 2
2. All segments of maxillary palpi about equally long (if segment 2 is twice as long as 3, gastral segment 2 is not distinctly petiolate and occipital carina ends below at short distance from hypostomal carina). — Oriental Region. 3
- Segment 2 of maxillary palpi more than twice as long as 3. 6
3. Mesoscutum shining, with sharply impressed prescutal sutures, running on outer side of anterior yellow marks backwards to level of tegulae. Head broadly oval, width about 1.4 to 1.5 times height of eye. Spiracles of gastral segment 2 clearly visible in dorsal aspect (Fig. 30). — Malaya, Sumatra, Borneo, Palawan, and Java. *Metischnogaster* gen. nov.
- Mesoscutum without prescutal sutures, or with ill-defined and shallow sutures on dull mesoscutum (in group of *Parischnogaster*). Spiracles of gastral segment 2 not visible in dorsal aspect 4
4. Occipital carina joins hypostomal carina near base of proboscideal fossa (Fig. 2). Gaster petiole long, more than 1.5 times length of thorax; segment 2 as a rule distinctly petiolate. Antennae rather strongly swollen beyond segment 6 or 7. Parameral spine of male genitalia dilated, forming a broad lamella with short apical spine. 5
- Occipital carina ending at short distance from hypostomal carina (Fig. 1). Gaster petiole less than 1.5 times length of thorax; segment 2 gradually narrowing towards base, not petiolate. Antennae only slightly clavate. Parameral spine normal. (Mid tarsi of ♂ not dilated, symmetrical.) — Burma and Thailand to Celebes and Java. *Liostenogaster* Van der Vecht

5. Clypeus longer than shortest interocular distance (Fig. 38 and 43). Mouthparts long, protruding beyond tip of clypeus over a distance well exceeding length of clypeus. Mid tarsi of ♂ very slender, symmetrical. — Borneo and Sumatra. *Holischnogaster* gen. nov.
- Clypeus rarely a little longer than shortest interocular distance. Mouthparts short, protruding less far beyond tip of clypeus. Mid tarsi of ♂ partly dilated, at least one segment asymmetrical. — India to Celebes. *Parischnogaster* Schulthess
6. Scutellum strongly convex, with sharp median carina. Mandibles of ♂ as a rule without teeth on inner side or, rarely (in species from continental S. E. Asia), with one very blunt and faintly indicated tooth. Proximal part of hind wing of ♂ with opaque greyish or brownish seam at posterior margin. Length to apex of second gastral segment exceeding 16 mm. — Southern India to Celebes. *Eustenogaster* Van der Vecht
- Scutellum more or less convex, but without median carina. Mandibles of ♂ with at least one distinct tooth on inner side. Hind wing of ♂ without dark seam. Length to apex of second gastral segment at most 14 mm. — New Guinea and some neighbouring islands. *Anischnogaster* Van der Vecht

Metischnogaster gen. nov.

(Fig. 2-37, Pl. 1, 2)

Head, including clypeus, wider than high (about 11 : 10 in ♀, 12.3 : 10 in ♂), and distinctly wider than thorax; width of head: height of eye = 14.5-15 : 10 in ♀ and 15.5-16 : 10 in ♂). Clypeus moderately convex, shining and sparsely punctate (♀) or practically impunctate (♂); anterior portion bluntly keeled in the middle and ending in a sharp point. Mandibles short, tridentate in ♀, bidentate in ♂. Segment 2 of maxillary palpi not lengthened; segment 1 of labial palpi long, but shorter than 2-4 together. Antennae moderately clavate, segment 10 less than twice as wide as segment 4; flagellum flattened and ventrally yellowish-white in ♂. Vertex with impressed median line (sometimes partly indistinct) between anterior ocellus and occipital carina.

Thoracic complex small, egg-shaped, and widest below tegulae; mesoscutum with distinct prescutal sutures, running from anterior margin along outer side of yellow marks to level of tegulae; parapsidal furrows starting a little in front of anterior tangent of both tegulae, before reaching posterior margin of mesoscutum a little dilated and bordered on outer side by fine carina. Scutellum moderately convex, faintly carinate mid-anteriorly. Metanotum rather strongly convex in profile. Propodeum shining, on posterior surface with oblique striation, transition between posterodorsal and lateral areas rounded; median line impressed, most distinctly at base and apex, and near the middle very slightly raised; valvulae strongly reduced. — In the ♂ the greater part of mesepisternum, metapleura and sides of propodeum take part in the formation of a dull, densely pubescent, sunken area. This area is bordered posteriorly by a sharp and more or less arcuate carina, situated between posterior margin of metapleura, just below propodeal spiracle, and apical margin of propodeum, close to posterior end of valvula.

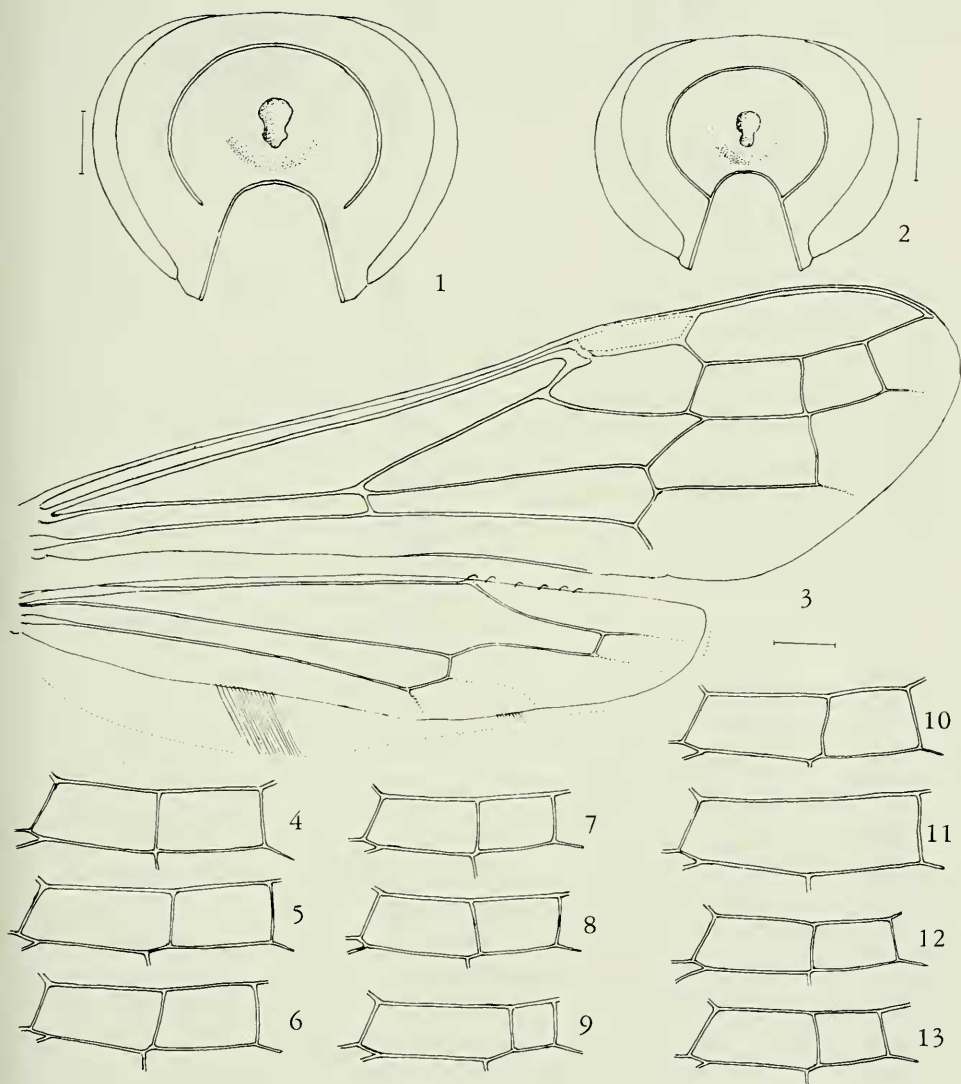


Fig. 1—2. Rear view of head (mouthparts and clypeus omitted). 1, *Liostenogaster nitidipennis* (Saussure) ♀, Borneo; 2, *Metischnogaster drewseni* (Saussure) ♀, Java. Fig. 3. Wings of *Metischnogaster drewseni* (Saussure) ♂, Java. Fig. 4—13. Submarginal cells 2 and 3 of right fore wing of *Metischnogaster*. 4—6, *M. cilipennis* (Smith) ♀, Malaya; 7—9, same, ♂, Malaya and Borneo (no. 9). 10, 11, *M. drewseni* (Saussure) ♀, Java (in 11 transverse vein absent in both wings); 12, 13, same, ♂, Java and Billiton. Scale lines represent 0.5 mm.

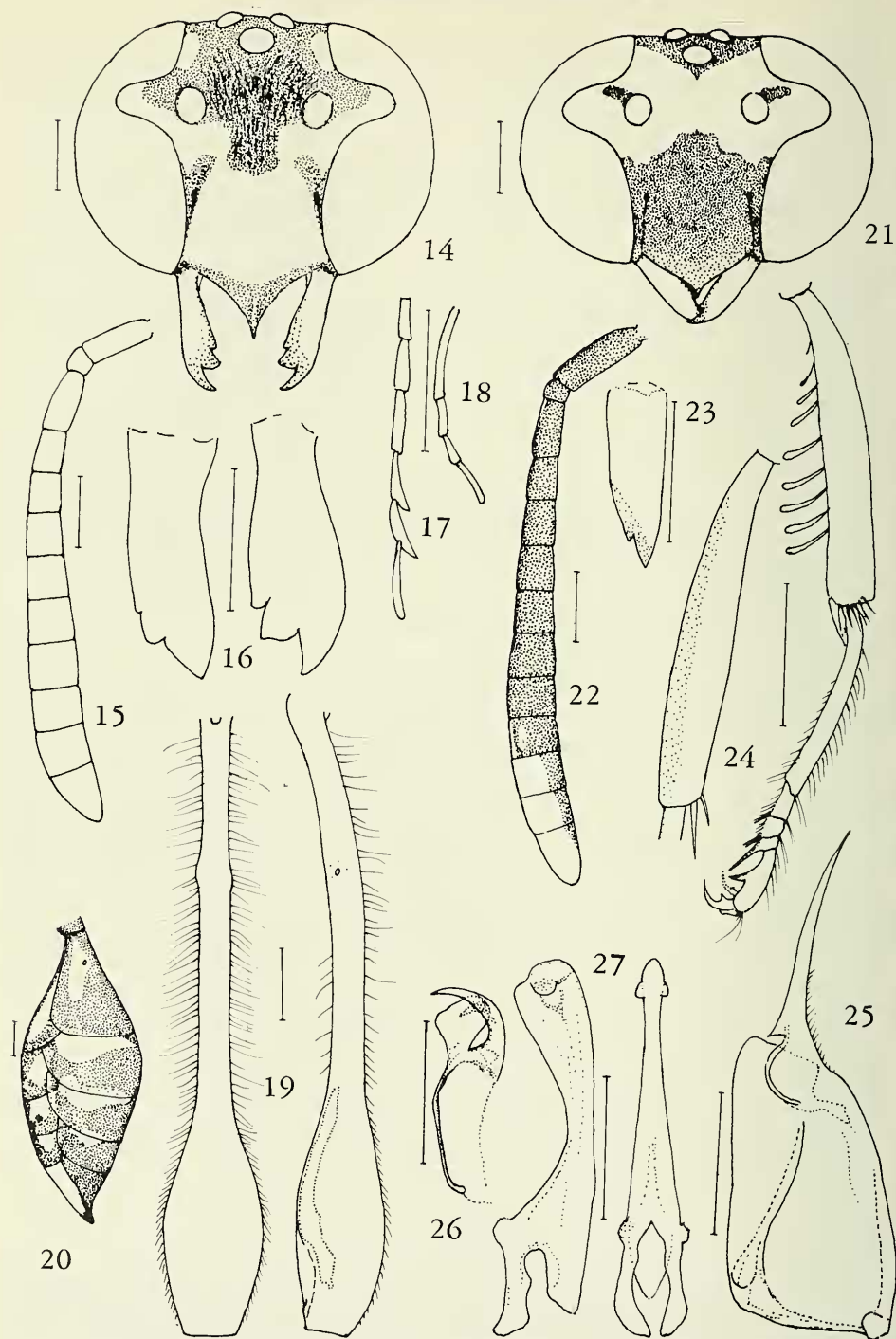


Fig. 14—20. *Metischnogaster cilipennis* (Smith) ♀, Malaya. 14, head; 15, antenna; 16, mandible, lateral and laterofrontal views; 17, maxillary palp; 18, labial palp; 19, gastral petiole, dorsal and lateral views; 20, gastral segments 2—6, lateral view. Fig. 21—27. *Metischnogaster cilipennis* (Smith) ♂, Malaya. 21, head; 22, antenna; 23, left mandible, lateral view; 24, fore tibia and tarsus, and mid tibia; 25, paramere; 26, volsella; 27, aedeagus, lateral and dorsal views. Scale lines represent 0.5 mm.

Legs slender, bearing numerous scattered long hairs, notably on coxae II and III, on trochanters, at base of ventral side of femora and on outer side of tibiae and tarsi; tibiae I of ♀ on inner side with irregular row of short spines. In ♂ tibiae I armed with a row of peculiar, slightly curved, spatulate setae (Fig. 24); tarsi II symmetrical; segment 4 of tarsi I and II produced beneath into a long spine, segment 5 with a shorter spine on ventral surface (Fig. 24 and 34).

Wings (Fig. 3-13) rather variable within the species as regards shape of second and third submarginal cells and course of second recurrent vein, the latter sometimes received in the third submarginal cell; sides of stigma almost parallel; hind wing narrow, with posterior fringe of anal cell in ♀ slightly lengthened, in ♂ very long.

Gastral petiole (Fig. 19 and 29) slender, greater part subcylindrical, somewhat asymmetrically swollen at spiracles, apical two-fifths swollen into elongate bulbus which is about 3.3 to 3.6 times as wide as the anterior part; tergite and sternite almost completely fused, the suture separating them visible only on apical two-thirds of ventral side of bulbus. Second segment (Fig. 20 and 30) at most shortly petiolate; spiracles close to base on dorsal surface. Terminal segment conical (♀) or with flattened sternite (♂). Male genitalia (Fig. 25-27, 35-37): parameral spine long, with sharp tooth at base; volsellar digitus sickle-shaped; aedeagus compressed, posterior part much higher than wide and near apex on each side with small lamellar or spiniform process, ventral processes rudimentary.

Length to apex of second gastral segment: 9-11 mm.

Type-species: *Ischnogaster cilipennis* Smith, 1857.

Distribution. — Malay Peninsula, Sumatra, Borneo, and Java.

Bionomics. — Our present knowledge of the life history of the two known species (possibly the only ones existing) is entirely due to investigations made in Malaya by H. T. Pagden (1958, 1962). The first paper deals with several *Stenogastrinae* and contains, in addition to a description and some figures of the peculiar characters of the ♂ of "*Stenogaster*" *cilipennis*, a note on the habit of hovering of these males and a drawing from a photograph of "the first nest ever found" of this species. A closely related species, supposed to be undescribed, but later identified as *drewseni*, was briefly mentioned. Further data are given in the second paper, which is exclusively devoted to the habits of these two species.

The nest of *M. cilipennis* (Pl. 1) consists of an almost straight row of rarely more than a dozen cylindrical cells, the first of which is usually attached to a hanging thread of the fungus *Marasmius* (horse-hair blight) or to hanging rootlets; each following cell is then built in a direct line with the preceding one, the openings of the cells being directed sideward. The nests are protected by one or more "ant guards", constructed of the same material as the cells (probably made sticky); they are difficult to find, being built in protected places, apparently often under overhanging banks (above or close to water) and screened by vegetation. The nests of the two species were found to be so similar, that no differences could be detected. The construction of the nest takes a long time, one nest of *M. drewseni* was observed to grow from 5 to 10 cells in about 4 months. Pagden noted that at least two females and two males were present on this nest when the sixth cell was about three-quarters complete. There is some evidence that the females of *M.*

cilipennis collect food by hovering in front of spider's webs from which they pick small Diptera. The peculiar habit of hovering and patrolling in favoured shady places was observed in the males of both species (Pl. 2).

KEY TO SPECIES OF METISCHNOGASTER

Females

1. Interocular part of clypeus almost entirely yellow; yellow marks at inner orbits coalescent with yellow clypeus or (in specimens from Borneo) separated. Tibiae III yellow on outer side. Anterior (dark) part of dorsal surface of propodeum indistinctly striate. Gastral petiole (Fig. 19) shorter in relation to width of bulbus, with numerous long, outstanding, hairs on cylindrical part and short hairs on bulbus. Gastral tergites 3 and 4 with basal yellow band (more or less hidden under preceding tergites), which is interrupted medially and dilated laterally *cilipennis* (Smith)
- Interocular part of clypeus yellow with broad, dark brown, median stripe (Fig. 28); yellow marks at inner orbits separated from those on clypeus. Tibiae III with short yellow line on outer side at base (absent in specimens from Java). Dorsal surface of propodeum entirely obliquely striate. Gastral petiole (Fig. 29) longer and less hairy, the short hairs on bulbus much sparser. Gastral tergites 3 and 4 each with two widely separated yellow spots. *drawseni* (Saussure)

Males

1. Terminal three or four antennal segments mainly whitish dorsally (note that the antennae may be more or less twisted). Markings of scutellum, metanotum and propodeum ivory-white, the latter mark well separated from the carina bordering the pubescent area. Metapleura without yellow spot. Gastral tergite 2 as a rule without yellow spot beneath spiracle. Aedeagus on each side with small subapical lamellar projection (Fig. 27) *cilipennis* (Smith)
- Terminal six or seven antennal segments (five in ♂ from Palawan) mainly, or at least partly, whitish dorsally. Markings of scutellum, metanotum and propodeum yellow (like the other thoracic markings), the last mentioned mark abruptly dilated at apex, forming a band along posterior margin of shiny part of propodeum. Metapleura with yellow spot beneath base of hind wing (not always distinct). Gastral tergite 2 with elongate yellow spot beneath spiracle. Aedeagus with small subapical tooth on each side (Fig. 37) *drawseni* (Saussure)

Metischnogaster cilipennis (Smith) (Fig. 4-9, 14-27)

Ischnogaster cilipennis Smith, 1857, Cat. Hym. Brit. Mus. 5: 92, ♂ — "Malacca (Mount Ophir)", leg. A. Wallace (lectotype by present designation BM, no. 18.713); 1858, J. Proc. Linn. Soc. Zool. 2: 113 (Sarawak, Borneo); 1871, J. Proc. Linn. Soc. Zool. 11: 378 (cat.). — Dalla Torre, 1894, Cat. Hym. 9:

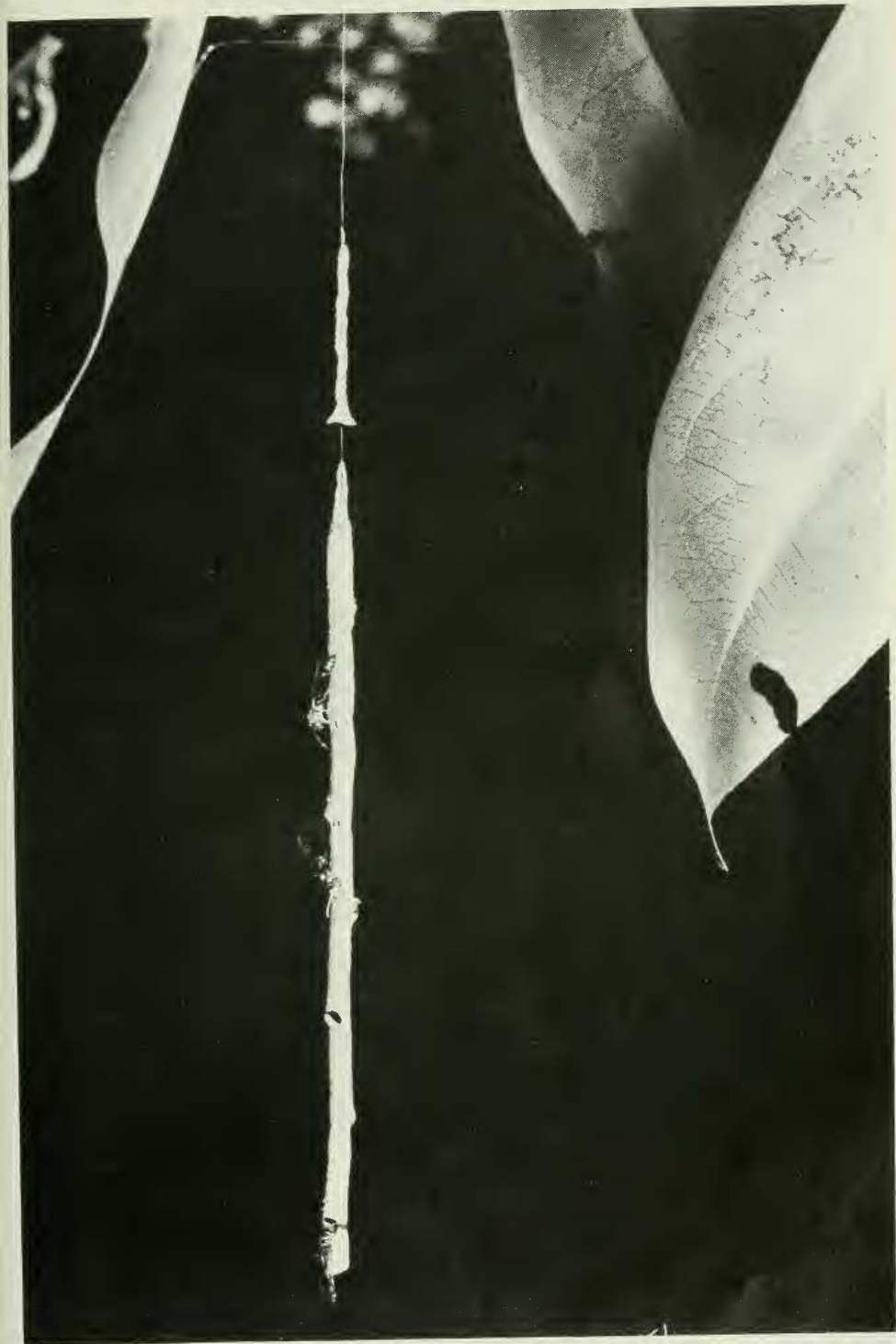


Plate 1. Nest of *Metischnogaster cilipennis* (Smith), built on thread of horse-hair fungus (*Marasmius*), $7\frac{1}{2}$ cells below "ant guard", with two female wasps (on cells 2 and 8) and one male (slightly reduced).
Malaya, Selangor, Ampang Reservoir, 9 May 1960.

Photograph by H. T. Pagden.

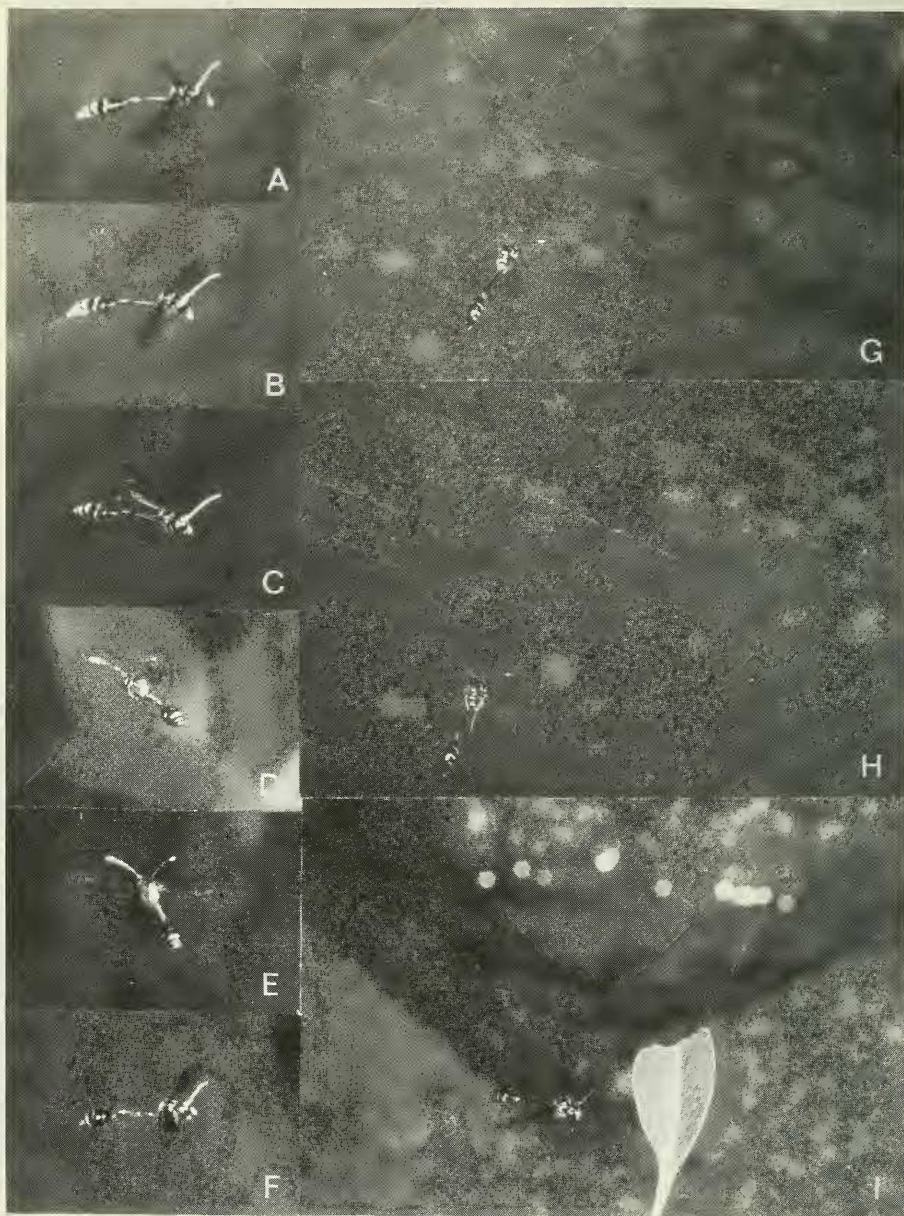


Plate 2. Left: hovering males of *Metischnogaster cilipennis* (Smith) (A-E) and *M. drewseni* (Saussure) (F); right: females of *M. cilipennis* searching at spider webs (slightly enlarged). Penang, Sungei Batu Feringgi, 11 April 1960.
Photographs by H. T. Pagden.

113 (cat.); 1904, *Genera Insect.* 19: 83 (cat.). — Schulthess, 1914, *Zool. Jb. Syst.* 37: 255 (in subgenus *Parischnogaster*).

Parischnogaster cilipennis; Schulthess, 1927, *Supplta ent.* 16: 87 (cat.).

Stenogaster cilipennis; Dover, 1931, *J. fed. Malay St. Mus.* 16: 256 (Perak and Pahang, Malaya). — Pagden, 1958, *Malay. Nat. J.* 12: 141—145, Fig. 21, 22 (characters; bionomics in Malaya); 1962, *Malay. Nat. J.* 16: 95-102, Pl. 13-15 (bionomics in Penang). — Yoshikawa c. s., 1969, *Nature & Life in S. E. Asia* 6: Pl. 34, 35 (nests, Malaya).

Note: for *Ischnogaster cilipennis* sensu Buysson, 1909, see under *M. drewseni* (Saussure).

Material. — Malaya: Perak, 2 ♂ Jor Camp, 2000 ft, 22 Aug. 1922, E. Seimund (BM); Pahang, 3 ♂ Sungei Tahang, 23 Nov. 1922, H. M. Pendlebury (BM); Selangor, Ampang Reservoir, 5 ♀ (nrs. 981-983, 985, 987) and 1 ♂ (980) ex nest, 9 July 1947, 2 ♀ (1091, 1092) and 4 ♂ (1093-1096) ex nest, 5 Oct. 1947, H. T. Pagden (BM, 3 ♀ 2 ♂ ML); do., 1 ♀ 29 Febr. 1948, ex nest, *Comm. Inst. Ent.* no. 10909, with note "see also nest sent 28.4.48, G. N." (BM); Selangor, 3 ♂ 40 km N. of Kuala Lumpur, 16 Sept. 1960, J. L. Gressitt (BISH, 1 ♂ ML), 1 ♂ Temple Park near Kuala Lumpur, 14 June 1973, D. K. McAlpine (AMS); Malacca, 3 ♂ Mt. Ophir (BM, lectotype and paralectotype; OUM, paralectotype).

Sumatra: N. E. Sumatra, 1 ♂ Serdang, Tandjong Morawa, Dr. B. Hagen (ML).

Borneo: Sarawak, 1 ♀ "Sar.", leg. A. Wallace (OUM), 1 ♂ Lundu, 21 Oct. 1909 (MCZ); East Borneo, 1 ♀ Tabang, Bengen River, 125 m, 5 Sept. 1956, 1 ♂ Balikpapan, Mentawir River, Oct. 1950, A. M. R. Wegner (ML).

Female

Head (Fig. 14), including clypeus, wider than long, preocular part of clypeus about 1/5 of total length; interocular distance on vertex slightly longer than at clypeus. Interocular part of clypeus in profile moderately convex, anterior part almost straight; the latter with blunt median carina ending in a sharp point. Mandibles: Fig. 16. Segment 2 of maxillary palpi slightly shorter than each of the following segments, segments 4 and 5 produced beyond the implantation of the next segment (Fig. 17). Segment 1 of labial palpi shorter than 2-4 together (4 : 5). Antennal segment 3 slightly shorter than scape (7 : 8), segment 10 less than twice as wide as segment 4. Ocelli large, transverse diameter of anterior one about 4/7 of its distance from inner orbit, posterior ocelli smaller and almost circular, farther from eyes than from each other (11 : 9), latter distance shorter than their diameter (9 : 10).

Gastral petiole (Fig. 19) slightly more than 1.5 times as long as thorax, its length about 6 times greatest width of bulbus.

Clypeus shining, slightly roughened medially, with scattered, superficial, setigerous punctures. Front and supraclypeal area less shining, longitudinally punctate-rugose, with short and low keel between and slightly in front of antennal sockets. Vertex shining, with some shallow and ill-defined punctures. Thorax generally smooth and shining, upper part of mesepisternum and lower part of metapleura very finely and superficially striate or punctate-striate; mesoscutum polished, with some scattered, setigerous, micropunctures. Dorsal surface of propodeum finely obliquely striate, basally the striation partly obsolete, the striae

meeting under a sharp angle medially. Gastral segments shining, almost smooth; a fine microsculpture is most distinct on the third and following segments.

Short to moderately long hairs are present on most parts of the body, those on the face have in certain lights a golden shine; longer hairs are most conspicuous on mandibles, anterior part of clypeus, vertex, metanotum, propodeum, proximal part of legs, cylindrical part of gastral petiole and on hind margin of gastral sternites.

Ground colour of head and thorax dark brown to black, gaster and legs slightly paler; bright yellow markings: on face and mandibles as shown in Fig. 14, most of pronotal collar, interrupted band at hind margin of pronotum (bluntly angular on outer side at shoulders), two elongate spots at anterior margin of mesoscutum and two spots close to its posterior margin, two spots on scutellum, two on mesepisternum (one close to base of fore wing, a lunate one below transverse suture), broad band on metanotum (incised posteriorly), large spot on upper part of metapleura, about posterior half of propodeum, coxae almost entirely, greater part of femora I, distal half or more of II and tip of III, tibiae I and II (except for brown stripe on inner side), dorsal stripe on tibiae III, basitarsus I above, short line on basitarsus II (sometimes lacking), curved stripe at lateral margin of tergal part of petiolar bulbus and some elongate spots on sternal part, more or less variable markings on postpetiolar part of gaster (Fig. 20). Wings subhyaline, strongly iridescent, veins and stigma dark brown.

Length (h. + th. + t. 1 + 2): 9.5-11 mm.

Male

Head (Fig. 21) relatively wider than in the ♀, anterior portion of clypeus shorter, mandibles weaker, bidentate, and with sharper teeth. Antennae flattened, apparently with rather soft underside (often shrivelled in dried specimens), scape relatively longer than in ♀ (about 1.5 times as long as segment 3). Pubescent area on sides of thorax large, including entire mesepimeron. Femora I strongly curved in frontal view, tibiae I with row of spatulate setae (Fig. 24), tibiae II compressed and dilated (Fig. 24), outer (anterior) surface bare, flattened and rather dull through fine sculpture, tarsal segments 1-3 of fore and mid legs with two rather long apical spines, 4 produced into a single long spine and 5 with shorter spine on ventral side (Fig. 24); scattered hairs on tarsi much longer than in ♀. Terminal gastral sternite flattened, truncate at apex. Genitalia: Fig. 25-27.

Colour pattern conspicuously different from that of ♀. Face dark brown (apex of clypeus paler) with broad, irregular, transverse yellow band (Fig. 21); ventral side of antennal scape and segment 2 polished and ivory-white, flagellum pale yellow beneath (on inner side when directed downwards), segments 11-13 mainly yellowish white above (Fig. 22) (in ♂ from Sumatra segments 10-13). Thorax without spots on lower part of mesepisternum and on metapleura; markings on scutellum, metanotum and dorsal surface of propodeum together forming one broad, longitudinal, subrectangular, ivory-white stripe. Coxae II and III partly brownish, femora brown with yellow mark at apex, tibiae I and II slightly darker than in ♀, III brown with at most a short yellow line at base; tarsi brown, dorsal surface of basitarsus I yellowish. Gastral petiole dorsally with whitish stripe, dilated on bulbus (anterior part may be partly indistinct or absent); no lateral

marks on bulbus and on tergite 2; 3 slightly paler anteriorly, 4 with basal yellow band, dilated in the middle and at the sides, 5 with wider basal whitish band, narrowed laterally, 6 mainly whitish, the dark posterior margin covering less than one-third of the tergite, sternites 2-6 pale brown, each with two yellow spots; terminal segment entirely whitish.

Length (h. + th. + t. 1 + 2): 9-10 mm.

***Metischnogaster drewseni* (Saussure) (Fig. 2, 3, 10-13, 28-37)**

Ischnogaster drewseni Saussure, 1857, *Annls Soc. ent. France* (3) 5: 315, ♂ — “Poulo-Pinang, Île de l’Archipel Indien”, leg. Drewsen (MHNG). — Smith, 1858, *J. Proc. Linn. Soc. Zool.* 2: 113 (Sarawak, Borneo; Mt. Ophir, Malaya). — Dalla Torre, 1894, *Cat. Hym.* 9: 113 (cat.); 1904, *Genera Insect.* 19: 83 (cat.). — Buysson, 1909, *Annali Mus. civ. Stor. nat. Genova* 44: 312 (syn. of *Ischnogaster cilipennis*). — Schulthess, 1927, *Supplta ent.* 16: 87 (cat., in synonymy of *Parischnogaster cilipennis* (Smith)).

Ischnogaster cilipennis; Buysson, 1909, *Annali Mus. civ. Stor. nat. Genova* 44: 312 (description of ♀, Lelemboli, Nias) [misidentification].

Stenogaster drewseni; Pagden, 1962, *Malay. Nat. J.* 16: 95-102, Pl. 13 (bionomics in Penang).

Material. — Malaya: Kedah, 2 ♂ near Jitra Catchment Area, 6 and 9 April 1928, H. M. Pendlebury (BM, ML); Penang, 1 ♂ “Poulo-Pinang” (= Penang), leg. Drewsen (type, MHNG), 1 ♂ Batu Feringgi Catchment Area, 2 June 1960, H. T. Pagden (BM), 1 ♀ 1 ♂ Sungei Pinang, 1500 ft, 3 June 1962, ex nest of 15½ cells on *Marasmius*, H. T. Pagden (ML), 3 ♂ Batu Feringgi, 25 Febr. - 1 March 1963, M. A. Lieftinck (ML); Selangor, 1 ♂ Ampang Waterworks Reserve, 15 Aug. 1926, C. Dover (BM).

Singapore: 1 ♀ coll. Baker (USNM).

Sumatra: Nias Isl., 1 ♀ Lelemboli, Aug. 1886, leg. Modigliani (*cilipennis* det. Buysson) (MCG); Palembang, 4 ♂ Pagar Alam, 750 m, 23 May 1935, Mrs. M. E. Walsh (BM, 1 ♂ ML).

Belitung Isl.: “West Billiton”, Tjerutjuk, sea level, 1 ♂ 2 Aug. 1935, 1 ♀ 2 ♂ 14 Dec. 1936, F. J. Kuiper (ML).

Borneo: 1 ♂ “Borneo”, leg. F. Bazes (NMW); Sarawak, 1 ♂ “Sarawak”, 1897, R. Shelford (BM); 8 ♂ Kuching, 1899-1900, Dayak collector, from R. Shelford (OUM, 2 ♂ ML), 1 ♀ River Kapah, trib. of R. Tinjan (MCZ).

Palawan: 2 ♂ Brooke’s Pt., Tigoplan River, 500-700 ft, Philipp. Zool. Exp., F. G. Werner leg. (CNHM, ML).

Java: West Java, Bogor (“Buitenzorg”), Djasinga, 150 m, at river Tjibarangbang, 2 ♂ April 1935 and Nov. 1936, 2 ♀ Febr. and June 1937, M. A. Lieftinck (ML), 1 ♀ 2 ♂ July 1937, J. and E. van der Vecht (ML); 1 ♂ Wijnkoop Bay, Dec. 1936, Mrs. M. E. Walsh (ML), 1 ♂ Djampang Wetan, Radjamandala, 1200 ft, Nov. 1937, Mrs. M. E. Walsh (BM).

Female

Very similar to *M. cilipennis*, but easily distinguished by the characters mentioned in the key on p. 64. Further differences are as follows.

Preocular part of clypeus slightly longer than one-fifth of length of head; interocular part in profile slightly less convex than in *M. cilipennis*; in centre of clypeus the interspaces between the punctures smooth and shining. Lateral areas

of mesoscutum (on outer side of prescutal furrows) superficially rugose and slightly less shining than in *M. cilipennis*.

Yellow markings rather constant, but the dark line on the clypeus frequently less narrowed at base than in Fig. 28.

Male

Apart from the colour characters mentioned in the key, distinguished by the mid tibia, which is less dilated (especially the basal half narrower), with outer side slightly convex and shiny and bearing a few outstanding hairs.

Yellow spot at apex of clypeus sometimes indistinct or absent; black supra-antennal mark may be smaller than in Fig. 31; pale stripe on dorsal side of antennae (Fig. 33) usually present on the terminal six segments, rarely also on segment 7 (in one ♂ from Java). Gastral tergite 1 with elongate dorsal spot on bulbus, 2 with lateral spot below spiracle, 3 brown or with small lateral spot, 4 and 5 with moderately wide yellow band in the middle of the tergite, separating an anterior translucent area (whitish in living insect?) from the dark posterior part, which is widened laterally, the yellow band often separated from a lateral spot of the same colour, 6 whitish with rather narrow dark posterior margin; sternites 2-5 mainly as in ♀, but some spots may be reduced or absent, 6 with irregular yellow band at base; terminal segment whitish, ventrally mainly yellow.

In the two males from Palawan only antennal segments 10-13 are mainly whitish dorsally, and the pale-coloured part of segment 9 covers less than its half. Since the mid tibiae of these males are somewhat duller than in the other specimens, examination of additional material from this island is desirable.

Holischnogaster gen. nov. (Fig. 38-49)

Head (Fig. 38 and 43), including clypeus, nearly as wide as high in ♀, slightly wider than high in ♂. Clypeus longer than wide, narrowed into a truncate point in ♀, in ♂ relatively shorter with nearly regularly triangular anterior portion. Mandibles rather long, tridentate, crossing when at rest. Malar space short in ♀, slightly longer in ♂. Mouthparts (Fig. 39 and 43) long, apical lobes of the narrow glossa (in preserved specimens) not divergent; segment 2 of maxillary palpi longer than other segments, but less than twice as long as any of these; segment 1 of labial palpi about as long as 2-4 together. Antennae clavate, gradually swollen from segment 6 to 10 (♀) or 11 (♂), and here more than twice as thick as at segment 6. Occipital carina meets hypostomal carina near base of proboscideal fossa. Vertex without impressed median line behind ocelli.

Thoracic complex (measured in lateral aspect) slightly longer than half the length of gastral petiole (4 : 7), general shape as in *Parischnogaster*, but in ♂ the sides without any trace of specialized pubescent areas. Mesoscutum without prescutal sutures.

Legs slender, not modified in ♂.

Wings mainly as in other Stenogastrinae, but the second submarginal cell only moderately wide and narrowed towards the radial cell, the first cross-vein (Rs) being rather strongly reclivous (front end farther from wing base than hind end).

Nervulus (cu-a) usually placed before the fork of M and Cu; vein Cu₁b strongly reclivous. Hamuli (wing hooks) 6-8, as usual in this subfamily, widely and somewhat irregularly spaced. Anal lobe of hind wing very small.

Gastral petiole (Fig. 40 and 41) slender, bulbus elongate, its width slightly more than three times the smallest width of the cylindrical part. Spiracles of petiole and

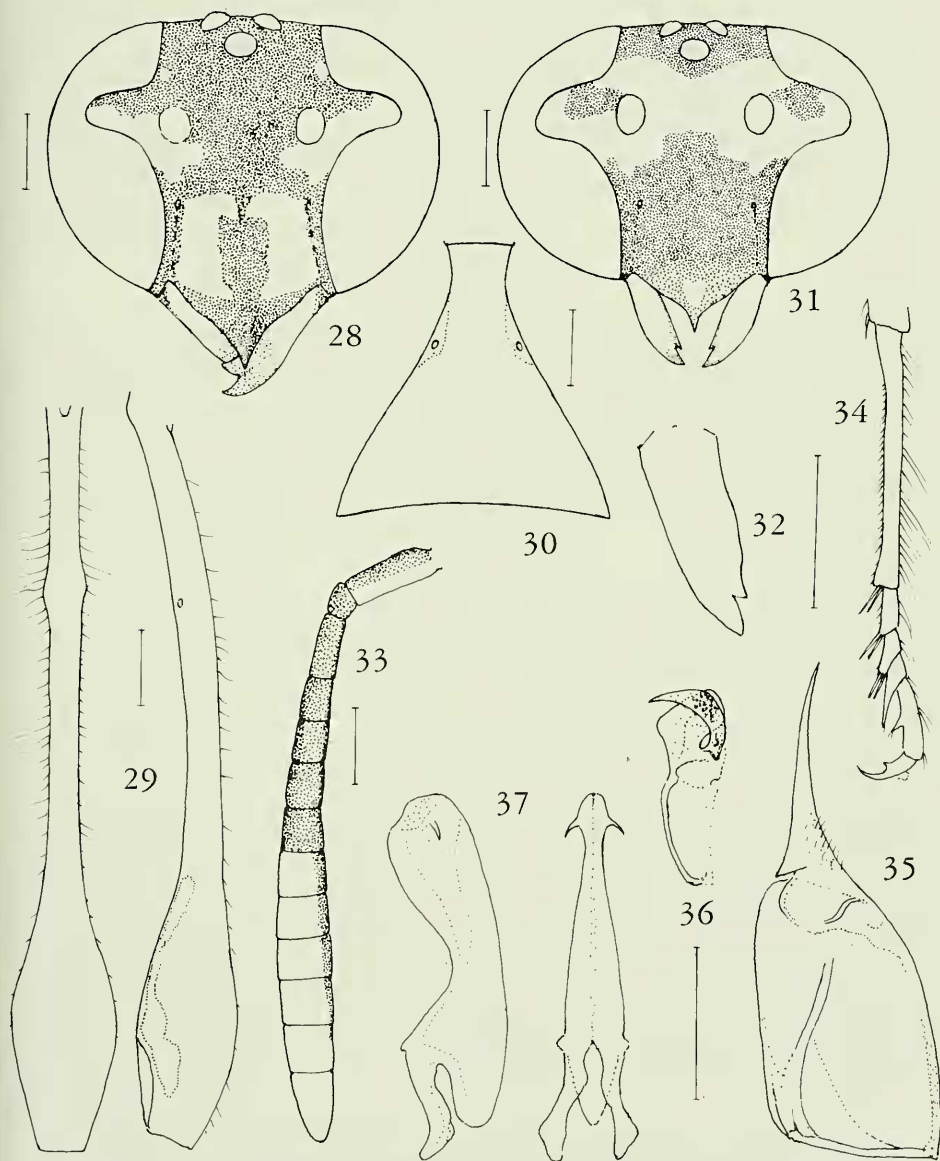


Fig. 28—30. *Metischnogaster drewseni* (Saussure) ♀, Penang. 28, head; 29, gastral petiole, dorsal and lateral views; 30, gastral segment 2, dorsal view. Fig. 31—37. *Metischnogaster drewseni* (Saussure) ♂, Java. 31, head; 32, mandible, lateral view; 33, antenna; 34, fore tarsus; 35, paramere; 36, volsella; 37, aedeagus, lateral and dorsal views. Scale lines represent 0.5 mm.

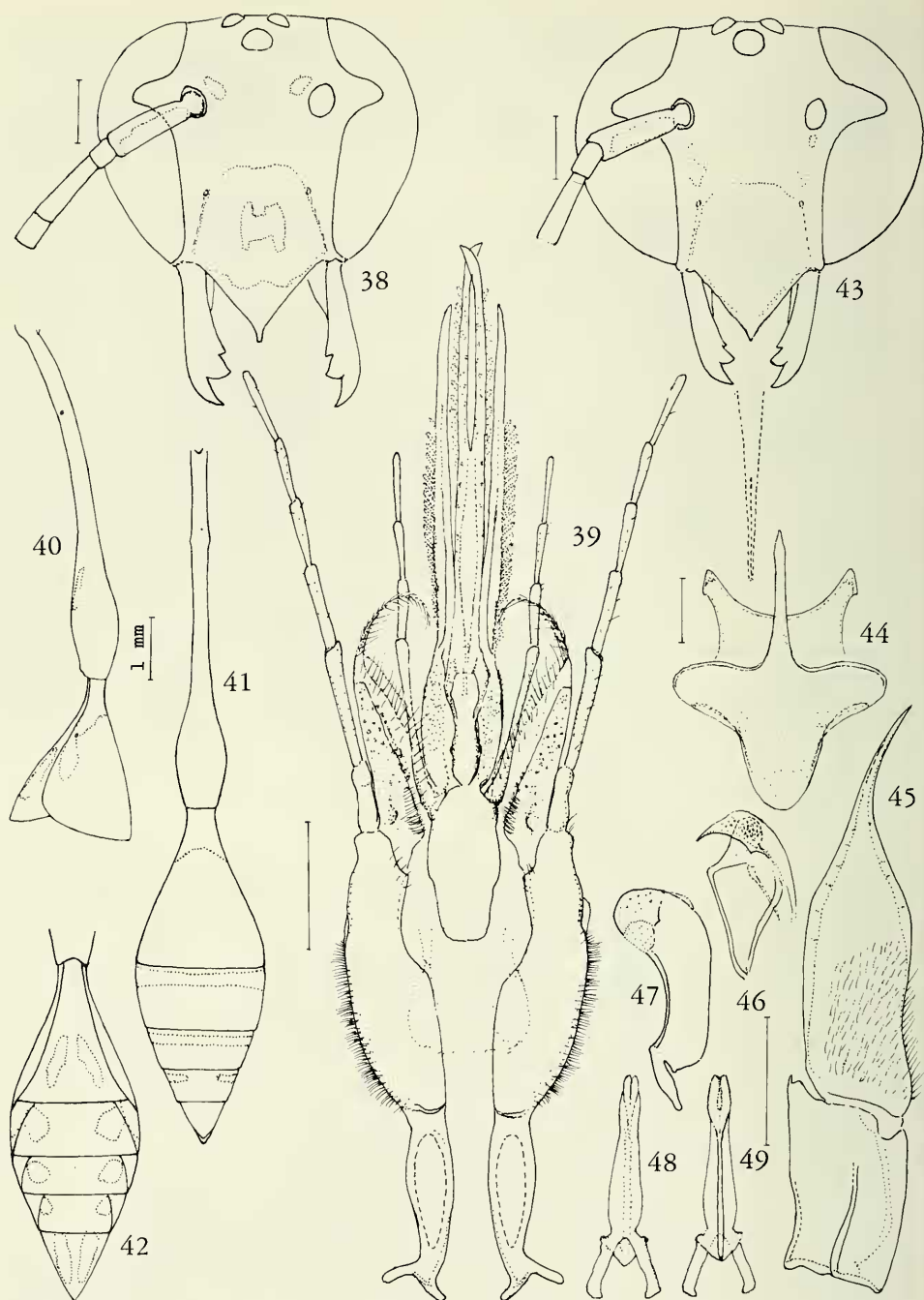


Fig. 38—42. *Holischnogaster gracilipes* sp. n. ♀, Borneo. 38, head; 39, mouthparts, ventral view; 40, gastral segments 1 and 2, lateral view; 41, gaster, dorsal view, segments 3—6 extended to show yellow markings; 42, segments 2—6, ventral view. Fig. 43—49. *Holischnogaster gracilipes* sp. n. ♂, Borneo. 43, head (length of glossa indicated by dotted lines); 44, gastral sternites 7—8, flattened; 45, paramere; 46, volsella; 47—49, aedeagus, lateral, ventral and dorsal views, respectively. Scale lines represent 0.5 mm (except Fig. 40 and 42).

segment 2 visible in ventral aspect, the latter distinctly placed before midlength of tergite. Segment 2 (Fig. 41) longer than wide at apex, slightly constricted at base. Male genitalia mainly as in *Parischnogaster mellyi* group, but aedeagus more strongly curved and higher.

Type species: *Holischnogaster gracilipes* spec. nov.

Distribution. — Borneo and Sumatra.

Note. — The type-species is closely related to *Parischnogaster*, as is evident from the structure of the male genitalia. I have provisionally treated it as a separate genus, because the lengthened mouthparts of both sexes and the non-dilated mid tarsi of the male suggest that there may be important differences in behaviour with regard to feeding and mating. Investigations on these points would be very valuable. Also discovery of the hitherto unknown nest construction might give important information on possible relationships.

***Holischnogaster gracilipes* spec. nov. (Fig. 38-49)**

Material. — Borneo: Sabah, 3 ♀ 5 ♂ Mt. Kinabalu, 5000 ft, 1-5 May 1973, K. M. Guichard (holotype ♀ and allotype ♂ in coll. Giordani Soika, paratypes: coll. Giordani Soika, 1 ♀ 2 ♂ ML); 1 ♂ Penrissen, May 1899, Shelford leg. (paratype, BM 1910-203); Sarawak, 1 ♀ Mt. Dulit, primary forest, 26 Oct. 1932, Oxford Univ. Exp., B. M. Hobby & A. W. Moore (BM 1933-254) (gaster lacking).

Sumatra: 1 ♂ Sungai Kumbang, Sept. 1915, Edw. Jacobson, no. 85-13 (antennae and gaster lacking) (ML).

Female

Clypeus faintly shining, punctate on microsculptured, reticulate-coriaceous ground; the punctures varying in size, small and close at the base, larger in centre and anteriorly and here separated by one or more puncture widths; apex of clypeus bluntly keeled. Supraclypeal area not distinctly separated from clypeus, dull and densely punctate, at level of lower margin of antennal sockets with short median keel (hardly more than elongate low tubercle). Frons and vertex dull, more rugosely punctate.

Pronotum dull, transversely rugose-striate, the striae coarsest in anterior-lateral angles. Mesoscutum and scutellum dull, densely rugose-punctate, the anteriorly dilated space between median scutal lines superficially roughened and more shining. Mesepisternum: upper part dull, irregularly obliquely striate, hypopimeral area slightly more shining and superficially rugose, transverse suture with row of punctures; ventral part swollen, rugosely punctate-striate, on each side with trace of precoxal suture. Metanotum finely rugose-punctate, metapleura moderately shining. Propodeum rather shining, finely obliquely striate, the striae sharply defined on dorsal surface, somewhat irregular and running into puncturation at lateral margins.

Gastral segments impunctate, with very fine and superficial microsculpture.

Face with short, appressed, golden pubescence and moderately long outstanding hairs; longer hairs are present at apex of clypeus and on mandibles. Pubescence of thorax and legs generally longer than in *Parischnogaster mellyi* (Saussure), gastral petiole with rather long outstanding hairs.

Ground colour dark brown to blackish; thorax, legs and abdomen partly pale brown; the following parts yellow: mandibles (brownish at margins and on teeth), clypeus (except for narrow band at anterior margin and irregularly shaped mark in centre), underside of antennal scape, spot on genae at mandible base, pronotal collar, band at posterior margin of pronotum, narrowly interrupted medially and strongly dilated at shoulders, two elongately triangular spots on anterior part of mesoscutum, broad band at base of scutellum and small spot on maxilla, large vertical spot on upper part of mesepisternum and an even larger one on lower part, bordering on the transverse suture, broad sublunate band on disk of metanotum and small triangular spot in anterior angle of lateral cavity, spot on metapleura beneath base of hind wing; propodeum except subquadrate area at base, produced on each side along anterior margin, and irregular band on lateral surfaces; greater part of coxae, lines on femora and tibiae I, II, and distal half of III, line on basitarsus of fore legs; markings on gaster as shown in Fig. 40-42.

Length (h. + th. + t. 1+2): 12-13 mm.

Male

Very similar to female, mainly differing in shape of head and clypeus (Fig. 43); yellow markings generally somewhat more extensive, but evidently rather variable; clypeus entirely yellow, supraclypeal area with yellow spot on each side (sometimes reduced, as in Fig. 43, or absent), yellow spot on genae larger than in ♀, spots on mesoscutum longer, in some specimens produced backwards as an interrupted line which ends at level of posterior margin of tegulae; dark area at base of propodeum reduced, subtriangular; yellow line on tibiae III either entire or narrowly interrupted; gastral tergite 1 with narrow lateral line on basal half of bulbus, 2 as in ♀, 3 with broad yellow basal band (anteriorly with brownish area narrowed towards the sides), the brown posterior part of the tergite covering less than half the length in the middle and much less at the sides; 4-6 with broad yellowish-white basal band, leaving only a narrow dark band at posterior margin, 7 yellowish-white on basal half; sternites mainly as in ♀, terminal sternite with yellow spot, its narrowed posterior part brownish.

Length apparently not different from that of ♀.

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